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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/932,236	08/16/2001	Haining Yang	MI22-1725	4828

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EXAMINER

HOGANS, DAVID L

ART UNIT PAPER NUMBER

2813

DATE MAILED: 08/06/2003

15

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/932,236

Applicant(s)

YANG, HAINING

Examiner

David L. Hogans

Art Unit

2813

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 03 July 2003.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 2,4,13,14 and 42-47 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 2,4,13,14 and 42-47 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 16 August 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

This Office Action is in response to Amendment D filed on July 3, 2003.

Status of Claims

Claims 2, 4, 13-14 and 42-47 are pending. Claims 1, 3, 5-12 and 15-41 are cancelled.

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 2, 4 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over 5,856,236 to Lai et al. in view of 6,211,034 to Visokay et al.

Claim 2

Lai et al. teaches: a semiconductor substrate (See column 3 lines 35-37); one or more metallo-organic precursors proximate the substrate wherein at least one does not comprise platinum (See columns 4-5 lines 55-20); exposing the precursor(s) to a reducing atmosphere (See column 4 lines 30-40); depositing the released metal over the substrate (See columns 4-5 lines 10-65); wherein the substrate comprises an upper surface consisting of TiN and TaN and is also exposed to the reducing atmosphere (See column 4 lines 1-15 and lines 30-40).

Lai et al. fails to explicitly teach patterning the metal containing mass into a rectangular block.

However, Visokay et al., in columns 6-7 lines 42-25 and Figures 2A-2G, teaches patterning Ruthenium, Iridium, Palladium or Rhodium, that has been deposited over Ti or TiN (see column 4 lines 1-10), into a rectangular block. Furthermore, Visokay et al. teaches one would pattern the metal containing mass to define a bottom electrode for use in sub-micron geometry DRAM devices.

It would have been obvious to one of ordinary skill in the art to modify Lai et al. by incorporating the patterning of Ruthenium, Iridium, Palladium or Rhodium into a rectangular block, as taught by Visokay et al., to define a bottom electrode for use in sub-micron geometry DRAM devices.

Claim 4

Incorporating all arguments of Claim 2 and noting that Lai et al. teaches wherein the metal comprising mass is formed physically against the upper surface (See column 4 lines 10-15 and Figure 2).

Claim 14

Incorporating all arguments of Claim 2 and noting that Lai et al. teaches wherein the reducing atmosphere comprises hydrogen (See column 4 lines 30-40).

3. Claims 42-47 are rejected under 35 U.S.C. 103(a) as being unpatentable over 5,856,236 to Lai et al. in view of 6,211,034 to Visokay et al. further in view of Semiconductor Manufacturing Technology (2001) to Quirk et al.

Claims 42-47

Incorporating all arguments of Claim 2 and noting that Lai et al., in column 4 lines 4-15, teaches depositing a metallo-organic metal over a titanium nitride or a tantalum nitride surface, but fails to explicitly teach wherein the upper surface is comprised by titanium, tantalum, tungsten or tungsten nitride. Furthermore, Visokay et al., in column 4 lines 1-10, teaches that Ruthenium, Iridium, Palladium and Rhodium can be deposited over titanium or titanium nitride.

However, Quirk et al., on pages 307-308, teaches that titanium, tantalum, tungsten and their nitrides are well known barrier metal layers within the art. Furthermore, Quirk et al. teaches that these refractory metals and their nitrides prevent intermixing of the materials above and below the barrier (i.e. – they prevent material diffusion problems).

It would have been obvious to modify Lai et al. and Visokay et al. by incorporating tantalum, tungsten or tungsten nitride as a barrier metal, as taught by

Quirk et al., to prevent intermixing of the materials above and below the barrier (i.e. – they prevent material diffusion problems).

4. Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over 5,856,236 to Lai et al. in view of 6,211,034 to Visokay et al. further in view of 5,907,789 to Komatsu.

Incorporating all arguments of Claim 2 and noting that Lai et al. and Visokay et al. fail to explicitly teach the deposition of a metallo-organic mass in a plasma activated hydrogen atmosphere.

However, Komatsu, in columns 21-22 lines 64-29, teaches the deposition of rhodium, iridium, cobalt, palladium or nickel by a plasma activated hydrogen (i.e. – a microwave power of 2.0 kW). Furthermore, Komatsu teaches that this layer forms a low resistance plug or interconnect.

It would have been obvious to one of ordinary skill in the art to modify Lai et al. and Visokay et al. by incorporating the deposition of rhodium, iridium, cobalt, palladium or nickel by a plasma activated hydrogen (i.e. – a microwave power of 2.0 kW), as taught by Komatsu, to form a low resistance contact or plug.

Response to Arguments

5. Applicant's arguments filed July 3, 2003, in Paper No. 14, have been fully considered but they are not persuasive.

The Applicant portends that Lai et al. fails to teach or suggest exposing one or metallo-organic precursors to a reducing atmosphere to release metal from the one or more precursors. Specifically, the Applicant contends that Lai's et al. disclosure of bubbling hydrogen gas through a metalorganic precursor is not equivalent to exposing the metallo-organic precursor to a reducing atmosphere because hydrogen is classified as an inert gas.

Initially, the Examiner notes that hydrogen is well known within the art as a reducing gas. Second, the Examiner notes that the Applicant discloses on page 5 paragraph [0016], that the reducing atmosphere can consist of hydrogen gas. Finally, 5,856,236 to Lai et al. and the present Application (09/932,236) are both assigned to Micron Technology (hence, the Examiner is uncertain how hydrogen gas is inert in the 5,856,236 patent but is reducing in the present Application when they perform the same process steps). Furthermore, the Examiner notes that 5,817,175 to Iyer, also assigned to Micron Technology, teaches exposing TDMAT (a metallo-organic precursor) to a hydrogen atmosphere, so as to deposit a metal (titanium) layer, wherein hydrogen scavenges free radicals.

Conclusion

6. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

5,817,175 to Iyer teaches exposing a metallo-organic precursor to a reducing/hydrogen atmosphere to form a metal layer.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to David L. Hogans whose telephone number is (703) 305-3361. The examiner can normally be reached on M-F (7:30-4:30).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead Jr. can be reached on (703) 308-4940. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7724 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-1782.

dh

August 4, 2003


CARL WHITEHEAD, JR.
SUPERVISORY PATENT EXAMINER
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